CLAIMS

What is claimed is:

1. A method of performing back-end manufacturing of an integrated circuit (IC) device comprising:

processing a die-strip through a front-of-line assembly portion which comprises a plurality of sub-stations operating on an in-line basis;

automatically providing said die-strip to an end-of-line assembly portion;

processing said die-strip by said end-of-line assembly portion which comprises a plurality of sub-stations operating on an in-line basis;

automatically providing said die-strip to a test assembly portion;

testing said die-strip using said test assembly portion;

automatically providing said die-strip to a finish assembly portion; and

processing said die-strip by said finish assembly portion which comprises a plurality of sub-stations operating on an in-line basis.

2. The method as recited in Claim 1 wherein said processing said die-strip by said front-of-line assembly portion comprises:

attaching dies to a strip to produce a die-strip using an in-line die attach sub-station;

curing said die-strip using an in-line cure sub-station;

cleaning said die-strip using an in-line plasma sub-station;

bonding said die-strip using an in-line bond sub-station; and

cleaning said die-strip using a second in-line plasma sub-station.

3. The method as recited in Claim 2 further comprising employing a camera system for automatic die-strip inspection and quality assurance within said front-of-line assembly portion.

4. The method as recited in Claim 1 wherein said processing said die-strip by said end-of-line assembly portion comprises:

molding said die-strip using an in-line mold sub-station;

post mold curing said die-strip using an in-line post mold cure sub-station;

attaching said die-strip using an in-line ball attachment sub-station;

sawing said die-strip using an in-line sawing sub-station; and

sorting said sawed die-strip using an in-line sorting sub-station.

5. The method as recited in Claim 1 wherein said processing said die-strip by said finish assembly portion comprises:

marking die-strip components using an in-line marking sub-station;

performing final visual inspection of said die-strip components using an in-line automated final visual inspection sub-station; and

processing said die-strip components by an in-line tape and reel sub-station.

6. The method as recited in Claim 2 wherein said front-of-line assembly portion is coupled on an in-line basis with said end-of-line assembly portion and wherein said processing said die-strip by said end-of-line assembly portion comprises:

molding said die-strip using an in-line mold sub-station;

post mold curing said die-strip using an in-line post mold cure sub-station;

attaching said die-strip using an in-line ball attachment sub-station;

sawing said die-strip using an in-line sawing sub-station; and

sorting said sawed die-strip using an in-line sorting sub-station.

7. The method as recited in Claim 6 wherein said end-of-line assembly portion is coupled on an in-line basis with said finish assembly portion and wherein said processing said die-strip by said finish assembly portion comprises:

marking die-strip components using an in-line marking sub-station;

performing final visual inspection of said die-strip components using an in-line final visual inspection sub-station; and

processing said die-strip components by an in-line tape and reel sub-station.

8. A method of back-end IC manufacturing comprising:

processing a die-strip through a front-of-line assembly portion which comprises: an in-line die attach sub-station; and an in-line bond sub-station;

automatically providing said die-strip to an end-of-line assembly portion;

processing said die-strip through said end-of-line assembly portion which comprises: an in-line post mold cure sub-station; and an in-line ball attachment sub-station;

automatically providing said die-strip to an in-line test assembly portion;

processing said die-strip by said test assembly portion;

automatically providing said die-strip to a finish assembly portion; and

processing said die-strip through said finish assembly portion which comprises an in-line final visual inspection assembly sub-station.

9. The method as recited in Claim 8 wherein said front-of-line assembly portion further comprises:

a cure sub-station;

a first plasma sub-station; and

a second plasma sub-station.

10. The method as recited in Claim 8 wherein said end-of-line assembly portion further comprises:

a mold sub-station;

a sawing sub-station; and

a sorting sub-station.

11. The method as recited in Claim 10 further comprising employing a camera system for automated die-strip inspection and quality assurance within said end-of-line assembly portion.

12. The method as recited in Claim 8 wherein said finish assembly portion further comprises:

a marking sub-station; and

a tape and reel sub-station.

13. The method as recited in Claim 9 wherein said front-of-line assembly portion is coupled in an in-line basis with said end-of-line assembly portion and wherein said end-of-line assembly portion comprises:

a mold sub-station;

a sawing sub-station; and

a sorting sub-station.

14. The method as recited in Claim 13 wherein said end-of-line assembly portion is coupled in an in-line basis with said finish assembly portion, said finish assembly portion comprising:

a marking sub-station; and

a tape and reel sub-station.

15. A back-end IC assembly method comprising:

processing a die-strip through a front-of-line portion of an assembly line, wherein said front-of-line assembly portion comprises a plurality of integrated sub-stations which each process said die-strip in an in-line fashion;

processing said die-strip through an end-of-line portion of said assembly line, wherein said end-of-line assembly portion comprises a plurality of integrated sub-stations which each process said die-strip in an in-line fashion; and

using in-line processes, performing test and finish assembly on said die-strip to produce a plurality of taped and reeled IC devices from said die-strip.

16. A method as described in Claim 15 wherein said front-of-line portion and said end-of-line portion are integrated together and further comprising said front-of-line portion automatically providing said end-of-line portion with said die-strip in an in-line fashion.

17. A method as described in Claim 16 wherein said processing said die-strip through said front-of-line portion comprises:

curing said die-strip using an in-line cure sub-station; and

cleaning said die-strip using an in-line plasma sub-station.

18. The method as recited in Claim 17 wherein said processing said die-strip through said front-of-line portion further comprises:

attaching dies to a strip to form a die-strip using a die attach sub-station;

bonding said die-strip using an in-line bond sub-station; and

cleaning said die-strip using a second in-line plasma sub-station.

19. A method as described in Claim 16 wherein said processing said die-strip through said end-of-line portion comprises:

sawing said die-strip using an in-line sawing sub-station; and

sorting said die-strip using an in-line sorting sub-station.

20. The method as recited in Claim 19 wherein said processing said die-strip through said end-of-line portion further comprises:

molding said die-strip using an in-line mold sub-station;

performing post mold curing using an in-line post mold cure sub-station; and

performing ball attachment of said die-strip using an in-line ball attachment sub-station.

21. A method as described in Claim 16 wherein said performing finish assembly comprises:

marking components of said die-strip using an in-line marking sub-station; and

processing said components of said die-strip using an in-line tape and reel sub-station.

22. The method as recited in Claim 21 wherein said performing finish assembly further comprises performing an automated final visual inspection using an in-line visual inspection sub-station.

23. The method as recited in Claim 22 wherein said performing finish assembly further comprises employing a camera system for automated die-strip inspection and quality assurance.

24. A method as described in Claim 16 wherein said performing test uses an in-line test portion of said assembly line and wherein said in-line test portion and said end-of-line portion are integrated together and further comprising said end-of-line portion automatically providing said test portion with said die-strip in an in-line fashion.

25. A method as described in Claim 23 wherein said performing finish assembly uses an in-line finish portion of said assembly line and wherein said in-line finish portion and said test portion are integrated together and further comprising said test portion automatically providing said finish portion with said die-strip in an in-line fashion.

26. An automated process for assembling, packaging, finishing and/or testing integrated circuits, comprising the steps of:

(a) attaching a plurality of integrated circuit die to a substrate in a die attach module under computer control;

(b) inspecting the substrate and attached die with a first automated machine vision system;

(c) automatically transporting the inspected attached die to a wire bonding module;

(d) bonding wires to both the substrate and the attached die in the wire bonding module under computer control;

(e) inspecting the wire-bonded die and substrate with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system;

(f) automatically transporting the inspected wire-bonded die and substrate to a molding module;

(g) encapsulating the inspected wire-bonded die and substrate with a mold material in the molding module under computer control;

(h) inspecting the encapsulated die and substrate with a third automated machine vision system, the third automated machine vision system being independent from or in electronic communication with the first and/or second automated machine vision system(s);

(i) automatically transporting the inspected encapsulated die and substrate to a singulation module;

(j) separating the inspected encapsulated die and substrate into separated die in the singulation module under computer control;

(k) inspecting the separated die with a fourth automated machine vision system, the fourth automated machine vision system being independent from or in electronic communication with the first, second and/or third automated machine vision system(s);

(l) automatically transporting the inspected separated die to a testing module; and

(m) testing the inspected separated die in the testing module under computer control.

27. The automated process of claim 26, further comprising the step of:

automatically transporting the tested die to a marking module; and

marking the tested die in the marking module under computer control.

28. The automated process of claim 27, further comprising the step of:

inspecting the marked die with a fifth automated machine vision system, the fifth automated machine vision system being independent from or in electronic communication with the first, second, third and/or fourth automated machine vision system(s).

29. The automated process of claim 26, further comprising the step of:

automatically transporting the tested die to a packaging module; and

packaging the tested die in the packaging module under computer control.

30. The automated process of claim 29, further comprising the step of:

inspecting the packaged die with a sixth automated machine vision system, the sixth automated machine vision system being independent from or in electronic communication with the first, second, third and/or fourth automated machine vision system(s).

31. The automated process of claim 29, wherein the packaging module comprises a tape and reel module.

32. The automated process of claim 26, further comprising the step of:

snap curing the attached die prior to the step of automatically transporting the inspected attached die to the wire bonding module.

33. The automated process of claim 26, further comprising the step of:

plasma cleaning the attached die prior to the step of automatically transporting the inspected attached die to the wire bonding module.

34. The automated process of claim 26, further comprising the step of:

plasma cleaning the wire-bonded die prior to the step of automatically transporting the inspected wire-bonded die to the molding module.

35. The automated process of claim 26, wherein the singulation module comprises a sawing module.

36. The automated process of claim 26, wherein the substrate comprises an n-by-m matrix array ball grid array type substrate, n and m each independently being an integer of at least 2.

37. The automated process of claim 26, further comprising the step of:

automatically loading wafers into a sawing module; and

sawing said wafers under computer control to provide said plurality of integrated circuit die.

38. An automated process, comprising the steps of:

(a) attaching a plurality of integrated circuit die to a substrate in a die attach module under computer control;

(b) inspecting the attached die with a first automated machine vision system;

(c) automatically transporting the inspected attached die to a molding module;

(d) encapsulating the attached die with a mold material in the molding module under computer control;

(e) inspecting the encapsulated die with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system;

(f) automatically transporting the inspected molded die to a testing module; and

(g) testing the inspected separated die in the testing module under computer control.

39. An automated process, comprising the steps of:

(a) attaching a plurality of integrated circuit die to a substrate in a die attach module under computer control;

(b) inspecting the attached die with a first automated machine vision system;

(c) automatically transporting the inspected attached die to a wire bonding module;

(d) bonding wires to both the substrate and the die in the wire bonding module under computer control;

(e) inspecting the wire-bonded die with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system;

(f) automatically transporting the inspected wire-bonded die to a molding module;

(g) encapsulating the inspected wire-bonded die with a mold material in the molding module under computer control.

40. An automated process, comprising the steps of:

(a) bonding wires to both a substrate and a plurality of die attached to said substrate in a wire bonding module under computer control;

(b) inspecting the wire-bonded die and substrate with a first automated machine vision system;

(c) automatically transporting the inspected wire-bonded die and substrate to a molding module;

(d) encapsulating the inspected wire-bonded die and substrate with a mold material in the molding module under computer control;

(e) inspecting the encapsulated die with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system(s);

(f) automatically transporting the inspected encapsulated die and substrate to a singulation module;

(g) separating the inspected encapsulated die and substrate in the singulation module under computer control.

41. An automated process, comprising the steps of:

(a) bonding wires to both a substrate and a plurality of die attached to said substrate in a wire bonding module under computer control;

(b) inspecting the wire-bonded die and substrate with a first automated machine vision system;

(c) automatically transporting the inspected wire-bonded die and substrate to a molding module;

(d) encapsulating the inspected wire-bonded die and substrate with a mold material in the molding module under computer control;

(e) inspecting the encapsulated die and substrate with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system(s);

(f) automatically transporting the inspected encapsulated die and substrate to a testing module; and

(g) testing the inspected encapsulated die and substrate in the testing module under computer control.

42. An automated process, comprising the steps of:

(a) encapsulating a substrate, a plurality of die attached to said substrate, and a plurality of wires bonded between each die and said substrate with a mold material in a molding module under computer control;

(b) inspecting the encapsulated substrate, die and wires with a first automated machine vision system;

(c) automatically transporting the inspected encapsulated substrate, die and wires to a singulation module;

(d) separating the inspected encapsulated substrate, die and wires in the singulation module under computer control to provide separated die;

(e) inspecting the separated die with a second automated machine vision system, the second automated machine vision system being independent from or in electronic communication with the first automated machine vision system(s);

(f) automatically transporting the inspected separated die to a testing module; and

(g) testing the inspected separated die in the testing module under computer control.